Ohio and Kentucky Approach to Data Archiving in Cincinnati

Presented by: Dave Gardner – Ohio DOT
Rob Bostrom – Kentucky Transportation Cabinet

TRB
82nd Annual Meeting
January 12-16, 2003, Washington D.C.

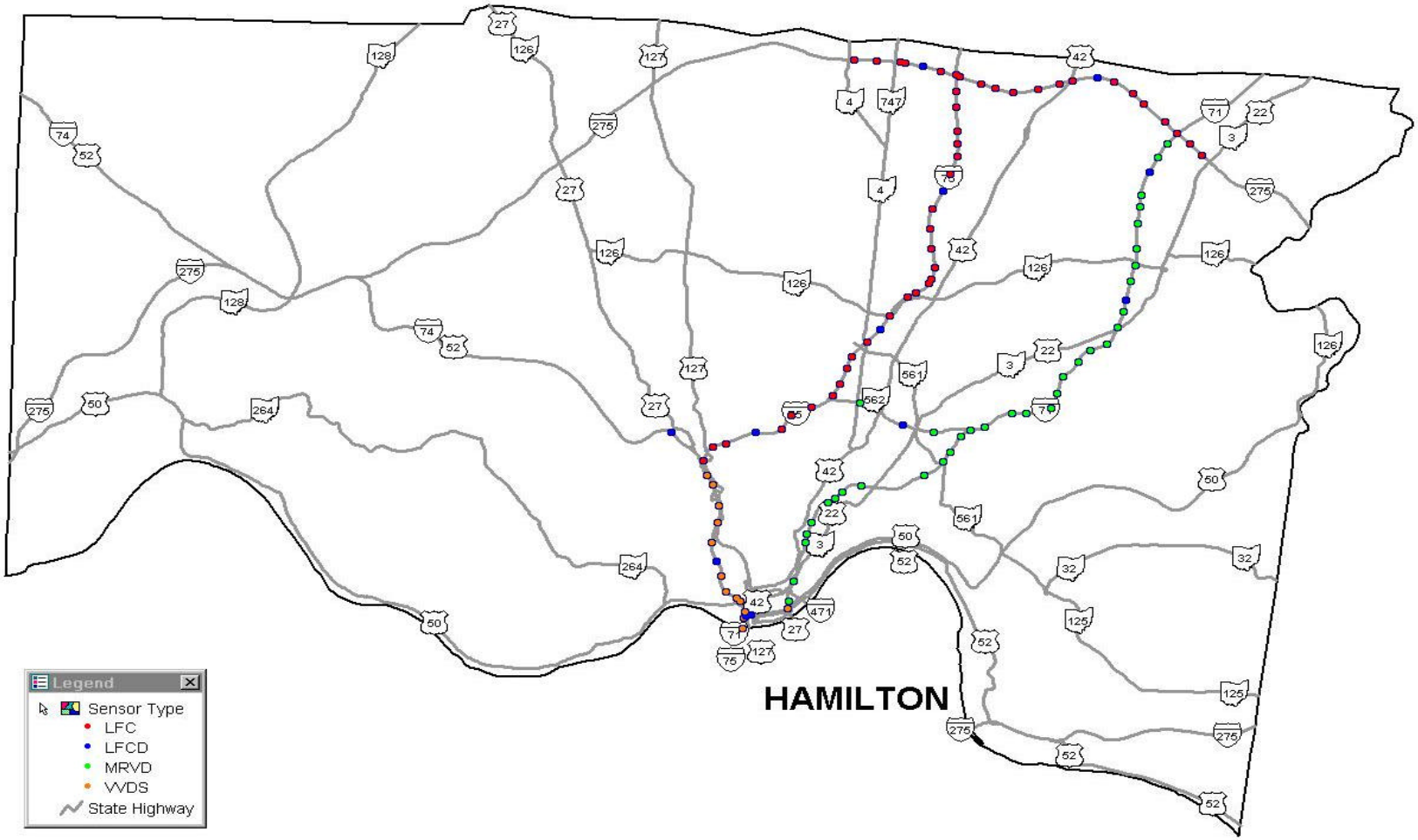
Ohio Presentation Overview

- ARTIMIS System Overview
- ARTIMIS Archived Data
- Data used by the DOT's
- Interfaces at Ohio DOT

ARTIMIS System Overview

- Covers 88 miles of highways in the Cincinnati-Northern Kentucky Regional Area.
- 1st major ITS effort in Ohio & 2nd on Kentucky.
- 80 Cameras, 57 miles of fiber, 1100 detectors, 40 fixed CMSs, 2 HARs, 5 patrol vans, Control Center in Downtown Cincinnati.
- 27 Total Employees
- Funding: 75% Ohio/25% Kentucky
- Operations and Maintenance - Outsourced currently to TRW
- ODOT Program Manager recently assigned to handle administrative tasks.

ARTIMIS Ohio Sensor Locations



ARTIMIS Archived Data

- Segment Archiver – Speed, Volume, Lane Occupancy (15 min. increment)
- Ramp Archiver – Speed, Volume, Lane Occupancy (15 min. increment)
- Segment/Ramp snapshot file – Speed, Volume, Occupancy (30 second increment)
- FHWA TMG 3 and C Cards
- “FHWA TMG” V, S, and L Cards

ARTIMIS Data Formats

- Segment/Ramp Archiver

Data for segment SEGO75035 for 10/03/2002
Number of Lanes: 3

# Time	Samp	Speed	Vol	Occ
05:20:13	30	52	353	3
05:35:13	30	54	492	4
05:50:13	30	57	771	6
06:05:13	30	57	784	6
06:20:13	30	58	994	8
06:35:13	30	57	1216	10
06:50:13	30	55	1499	13
07:05:13	30	56	1422	12
07:20:13	30	56	1521	13
07:35:13	30	49	1539	16

- Segment/Ramp Snapshot

Segment: SEGO75035 Generated by Warning, Alarm 107191

Time	Speed	Volume	Occupancy
10:38:43	44	53	18
10:39:13	45	40	14
10:39:44	47	39	13
10:40:13	51	38	12
10:40:43	60	38	10
10:41:14	60	36	9
10:41:43	50	38	11
10:42:13	60	40	10
10:42:43	52	48	14
10:43:14	55	38	10
10:43:43	57	50	13
10:44:13	54	41	12
10:44:44	54	40	11

ARTIMIS Data Formats

Original ARITIMIS Plan

- TMG 3 Card Format
  - Vehicle Volume
  - 60 min. increment
- TMG C Card Format
  - Vehicle Classification
  - 60 min. increment

Additional Formats

- V – Card
  - Vehicle Volume
  - 5 min. increment.
- L – Card
  - Vehicle Length
  - 15 bins, 5 foot increments, 0-15ft to >70ft.
- S – Card
  - Vehicle Speed
  - 15 bins, 5 mph increments, 0-20 mph to >85 mph

ARTIMIS Data Formats

L - Card

Item	Columns	Width	Alpha/Numeric	Description
1	1 - 1	1	A	L
2	2 - 3	2	N	21, 39
3	4 - 9	6	A	Sta.no.
4	10 - 10	1	N	Direction
5	11 - 11	1	N	Lane
6	12 - 13	2	N	Year
7	14 - 15	2	N	Month
8	16 - 17	2	N	Day
9	18 - 19	2	N	Hour
10	20 - 24	5	N	Total volume for time interval
11	25 - 29	5	N	Length 1 count for time interval
12	30 - 34	5	N	Length 2 count for time interval
13	35 - 39	5	N	Length 3 count for time interval
14	40 - 44	5	N	Length 4 count for time interval
15	45 - 49	5	N	Length 5 count for time interval
16	50 - 54	5	N	Length 6 count for time interval
17	55 - 59	5	N	Length 7 count for time interval
18	60 - 64	5	N	Length 8 count for time interval
19	65 - 69	5	N	Length 9 count for time interval
20	70 - 74	5	N	Length 10 count for time interval
21	75 - 79	5	N	Length 11 count for time interval
22	80 - 84	5	N	Length 12 count for time interval
23	85 - 89	5	N	Length 13 count for time interval
24	90 - 94	5	N	Length 14 count for time interval
25	95 - 99	5	N	Length 15 count for time interval
26	100 - 100	1	A	Footnotes

ARTIMIS Data Formats

“S” - Card

Item	Columns	Width	Alpha/Numeric	Description
1	1 - 1	1	A	S
2	2 - 3	2	N	21, 39
3	4 - 9	6	A	Sta.no.
4	10 - 10	1	N	Direction
5	11 - 11	1	N	Lane
6	12 - 13	2	N	Year
7	14 - 15	2	N	Month
8	16 - 17	2	N	Day
9	18 - 19	2	N	Hour
10	20 - 24	5	N	Total volume for time interval
11	25 - 29	5	N	Speed 1 count for time interval
12	30 - 34	5	N	Speed 2 count for time interval
13	35 - 39	5	N	Speed 3 count for time interval
14	40 - 44	5	N	Speed 4 count for time interval
15	45 - 49	5	N	Speed 5 count for time interval
16	50 - 54	5	N	Speed 6 count for time interval
17	55 - 59	5	N	Speed 7 count for time interval
18	60 - 64	5	N	Speed 8 count for time interval
19	65 - 69	5	N	Speed 9 count for time interval
20	70 - 74	5	N	Speed 10 count for time interval
21	75 - 79	5	N	Speed 11 count for time interval
22	80 - 84	5	N	Speed 12 count for time interval
23	85 - 89	5	N	Speed 13 count for time interval
24	90 - 94	5	N	Speed 14 count for time interval
25	95 - 99	5	N	Speed 15 count for time interval
26	100 - 100	1	A	Footnotes

ARTIMIS System Design

- Archiver Processing
  - Programming Language: C
  - Database: Sybase ASE 12.0
  - Interface: OpenClient Database Interface
  - Operating System: HP-UX 11.0
  - Program Size: 3M - FHWA, 5M - Segment
  - File Size for S, V Records: 1M to 1.3M
  - File Size 3, C Records: 170K to 300K

ARTIMIS System Design

- Segment /Ramp archivers run on a per corridor basis (currently 57 corridors) and data is collected/stored internally for every 15 min. and a file is created per day basis.
- Segment/Ramp records transferred in Winzip format at end of every month.
- FHWA format written to internal data structure every 15 mins. Cumulative information is written to files every night.
- FHWA archivers transferring program written in Perl.
- Data accessed thru ftp site.
- Data storage done at RedHat Linux system with 80GB hard disk.

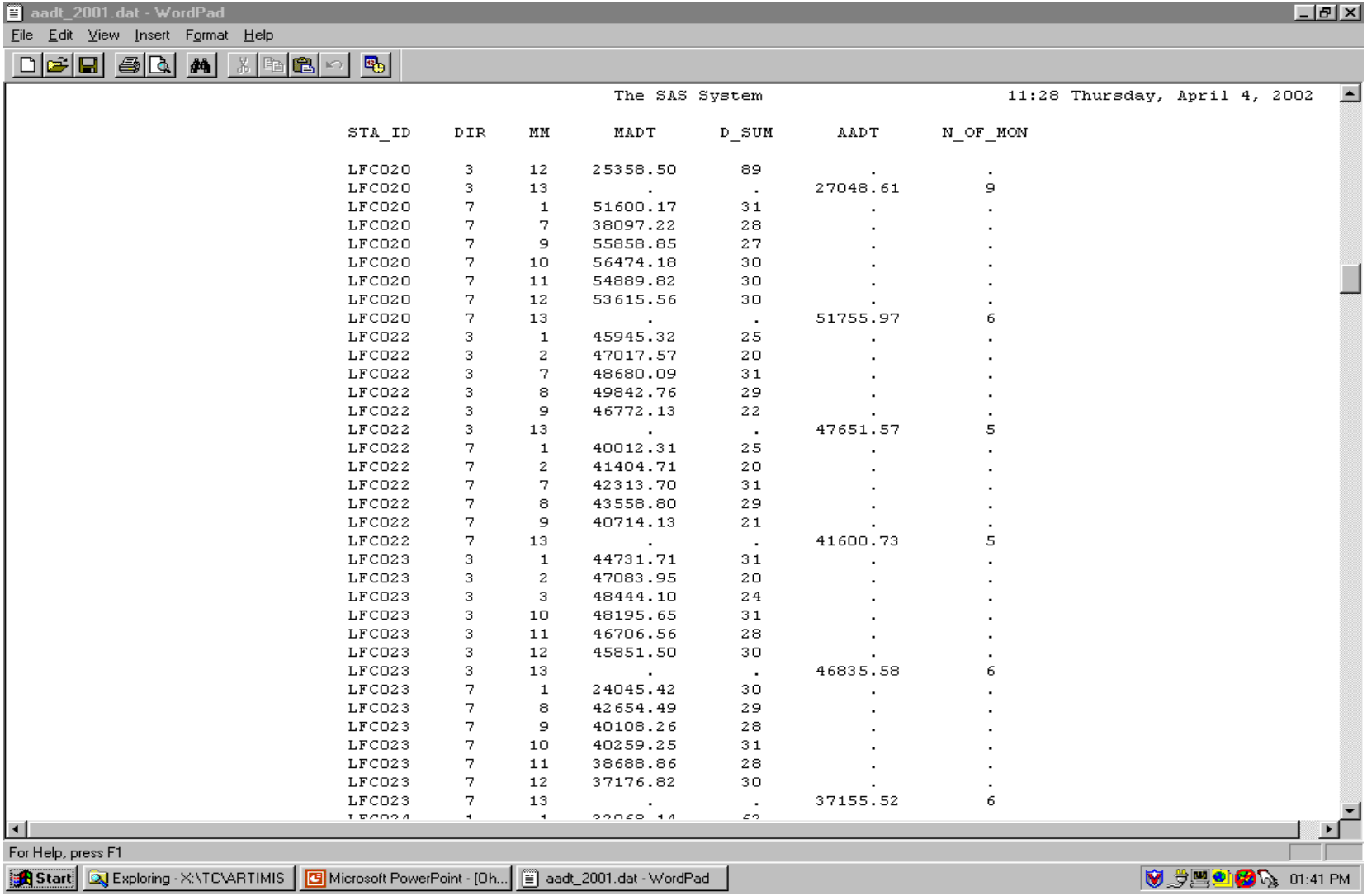
ARTIMIS System and Archiving Costs

- Approx. $30M Design & Construction
- $4.5M Annual Operations & Maintenance
  - 24/7 Operations (including FSP) – 80%
  - Facility Mgmt (includes utilities) – 11%
  - Equipment Maintenance – 8%
  - Public Relations – 1%
- Approx. 2-3 months to write TMG format program. Approx. one week to modify for S and V records.
- Approx. 2 months to write procedures that clean-up accounts monthly and .zip the files for access on ftp server.
- All of these costs were shared by the ODOT and Kentucky in the contract.

ODOT Interfaces

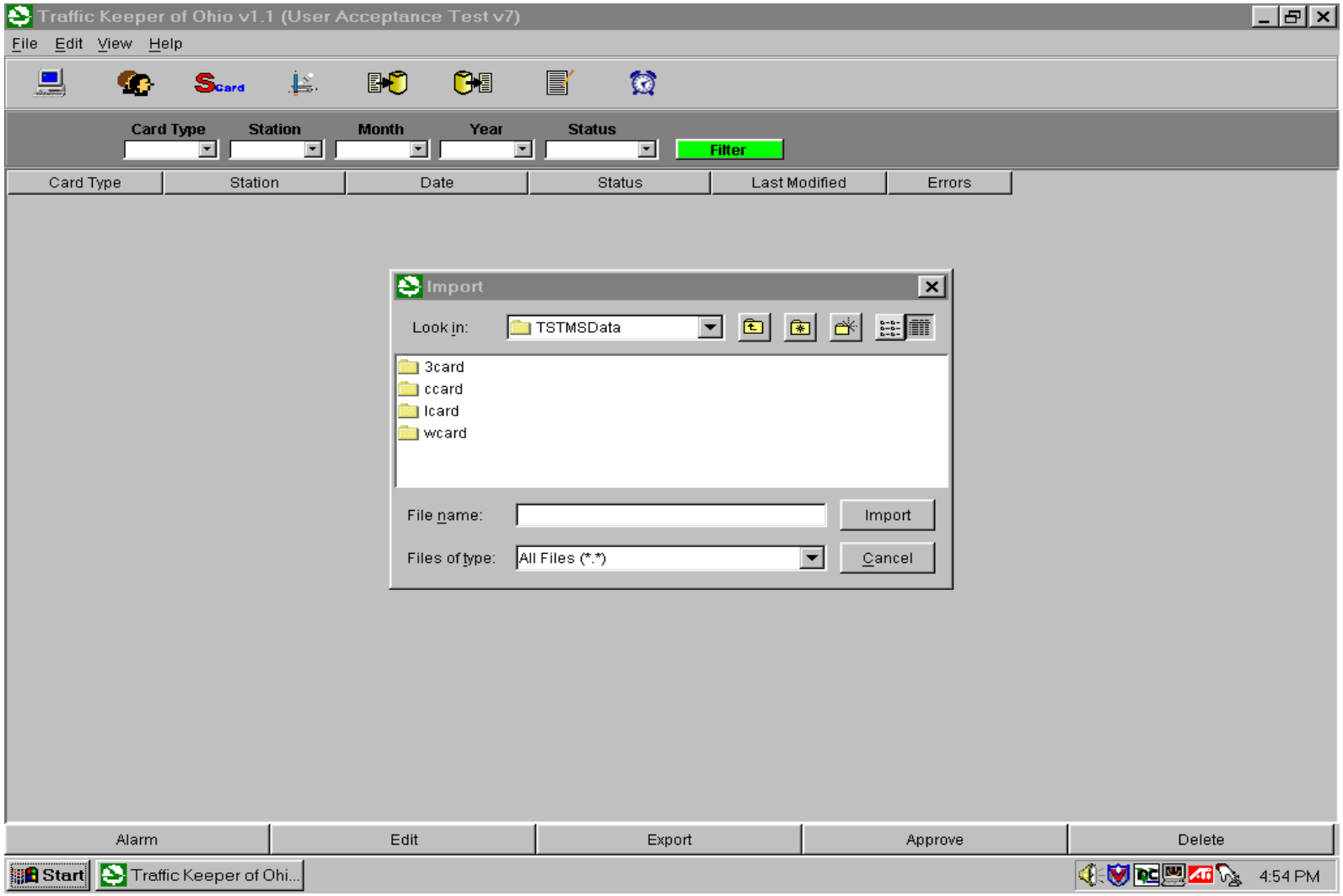
- SAS Program to generate ADT's
- TMG files to be loaded into ODOT TKO Software
  - Data Alarms (Volume, Length, Vehicle Classification)
  - Data Editing
  - Data Repository
- Web Reporting Tools
  - Volume
  - Length
  - Classification
  - Analytical

ODOT Interfaces – SAS

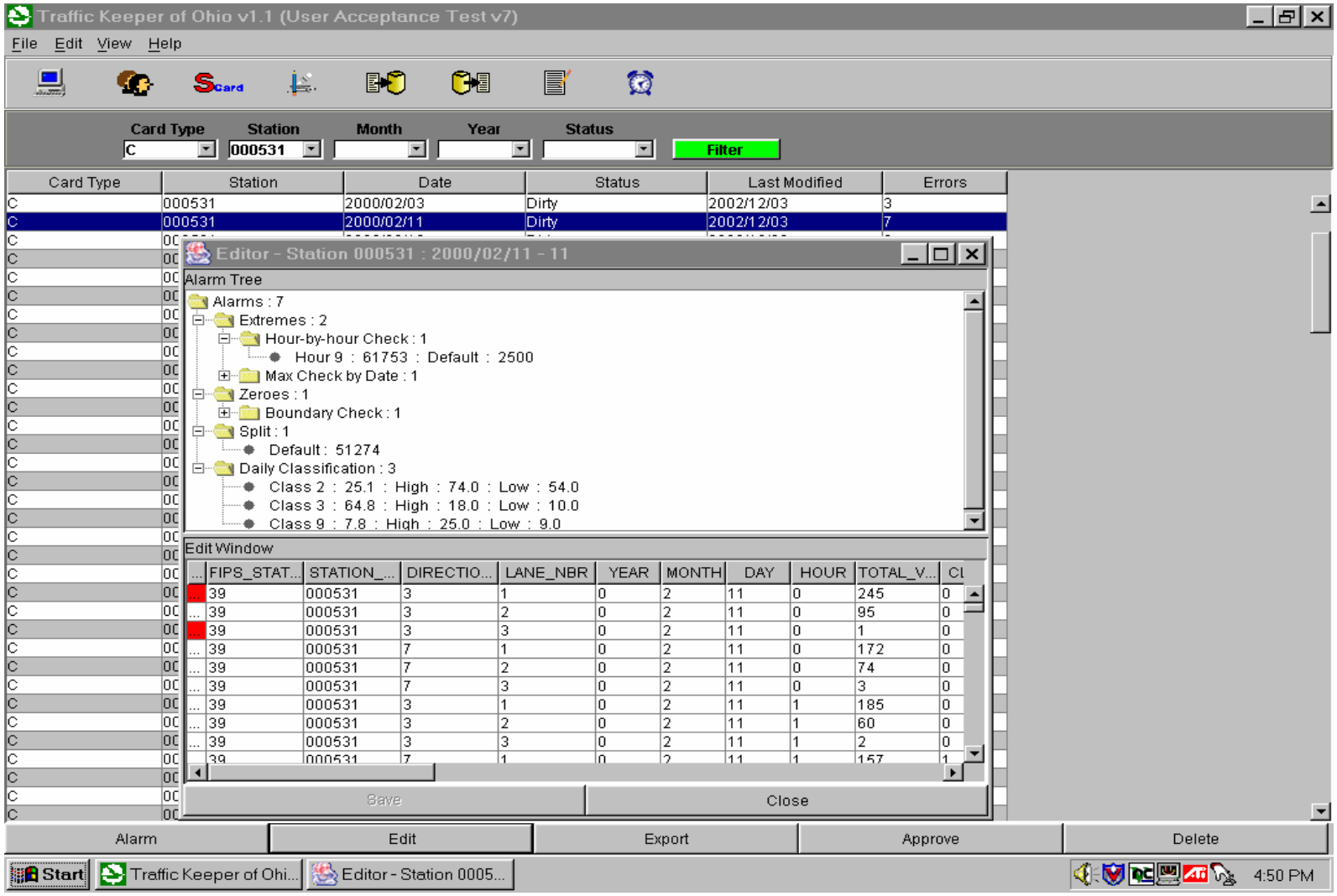


STA_ID	DIR	MM	MADT	D_SUM	AADT	N_OF_MON
LFC020	3	12	25358.50	89	.	.
LFC020	3	13	.	.	27048.61	9
LFC020	7	1	51600.17	31	.	.
LFC020	7	7	38097.22	28	.	.
LFC020	7	9	55858.85	27	.	.
LFC020	7	10	56474.18	30	.	.
LFC020	7	11	54889.82	30	.	.
LFC020	7	12	53615.56	30	.	.
LFC020	7	13	.	.	51755.97	6
LFC022	3	1	45945.32	25	.	.
LFC022	3	2	47017.57	20	.	.
LFC022	3	7	48680.09	31	.	.
LFC022	3	8	49842.76	29	.	.
LFC022	3	9	46772.13	22	.	.
LFC022	3	13	.	.	47651.57	5
LFC022	7	1	40012.31	25	.	.
LFC022	7	2	41404.71	20	.	.
LFC022	7	7	42313.70	31	.	.
LFC022	7	8	43558.80	29	.	.
LFC022	7	9	40714.13	21	.	.
LFC022	7	13	.	.	41600.73	5
LFC023	3	1	44731.71	31	.	.
LFC023	3	2	47083.95	20	.	.
LFC023	3	3	48444.10	24	.	.
LFC023	3	10	48195.65	31	.	.
LFC023	3	11	46706.56	28	.	.
LFC023	3	12	45851.50	30	.	.
LFC023	3	13	.	.	46835.58	6
LFC023	7	1	24045.42	30	.	.
LFC023	7	8	42654.49	29	.	.
LFC023	7	9	40108.26	28	.	.
LFC023	7	10	40259.25	31	.	.
LFC023	7	11	38688.86	28	.	.
LFC023	7	12	37176.82	30	.	.
LFC023	7	13	.	.	37155.52	6

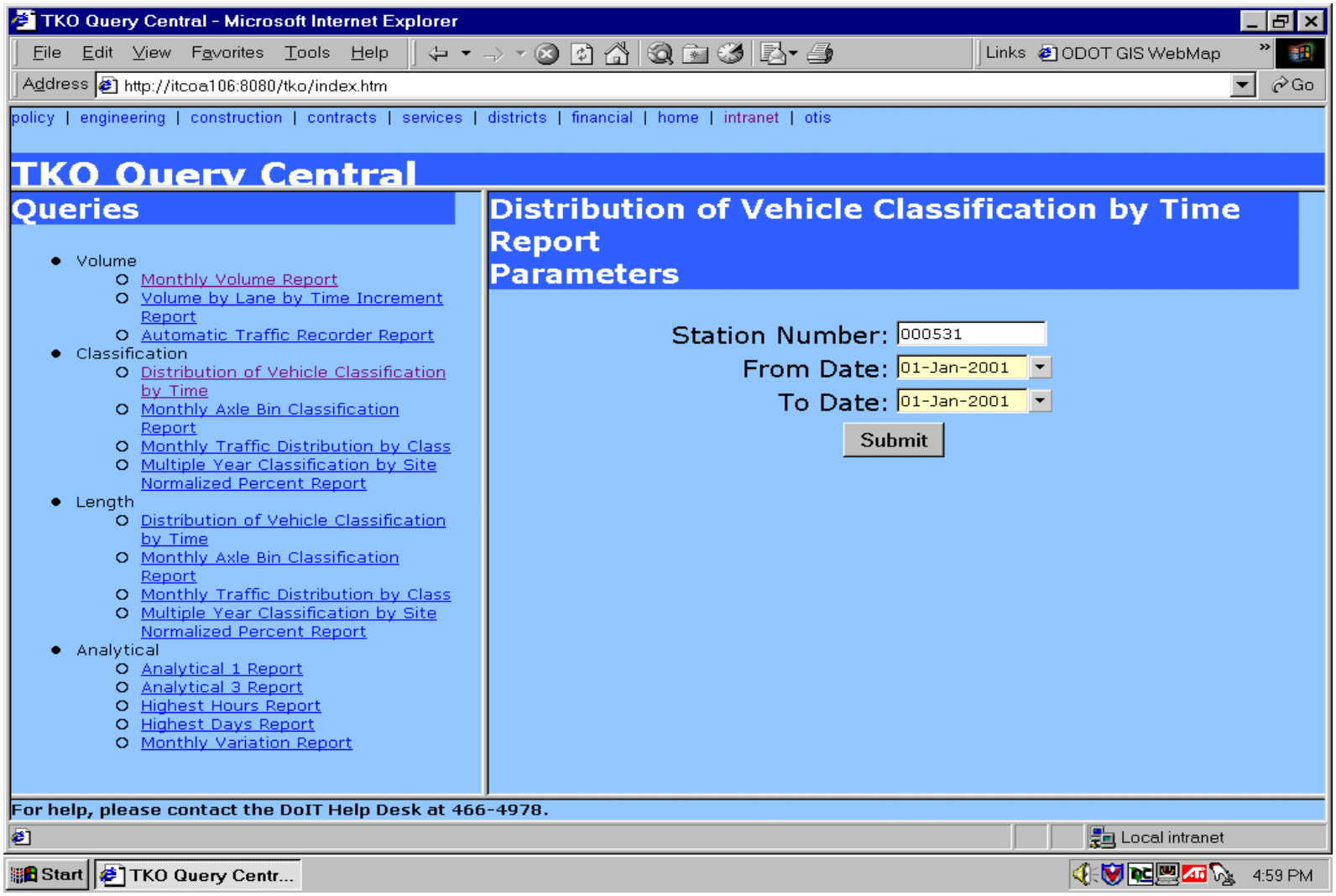
ODOT Interfaces – TKO Software



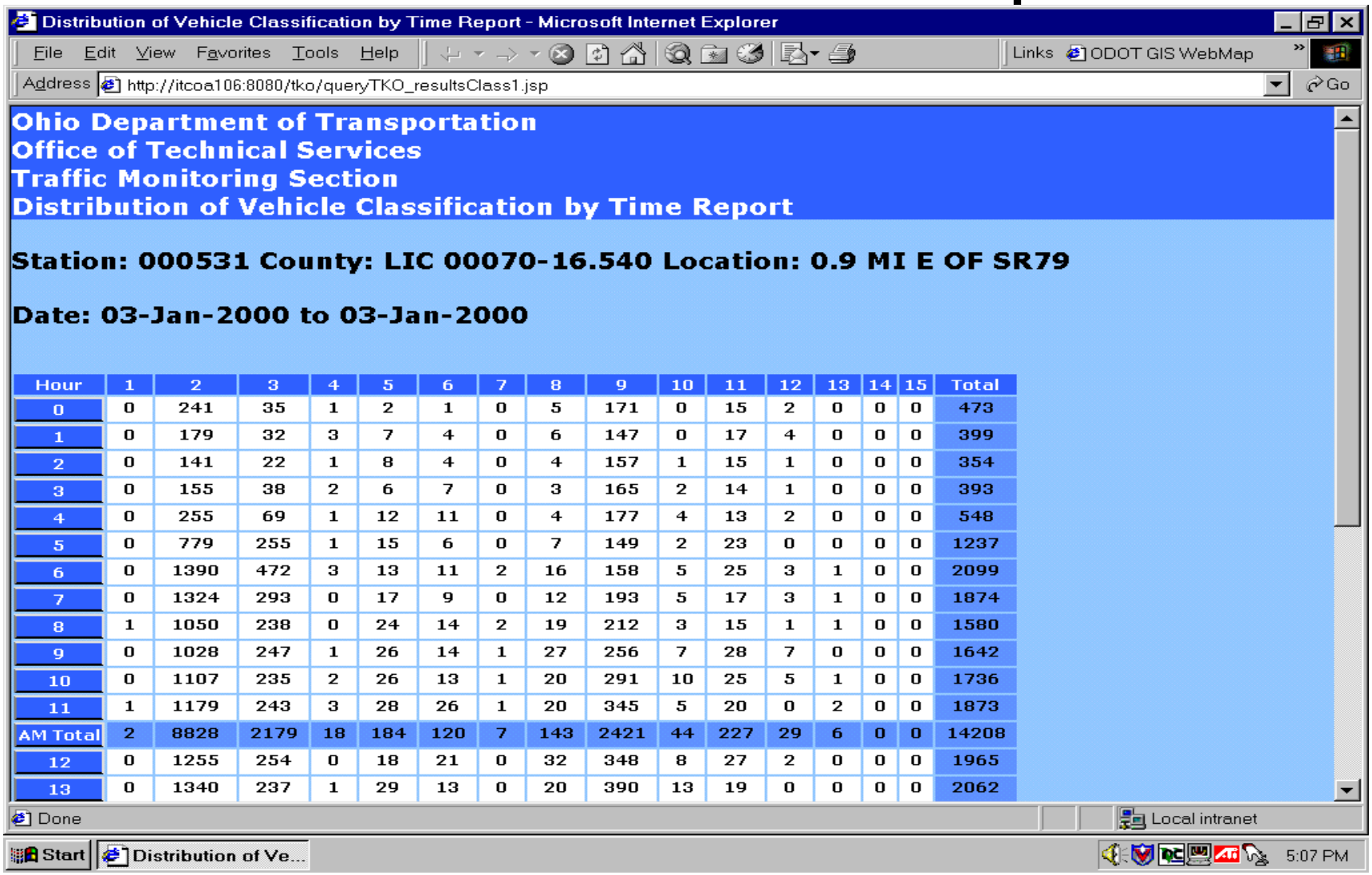
ODOT Interfaces – TKO Software



ODOT Interfaces – Reports



ODOT Interfaces – Reports



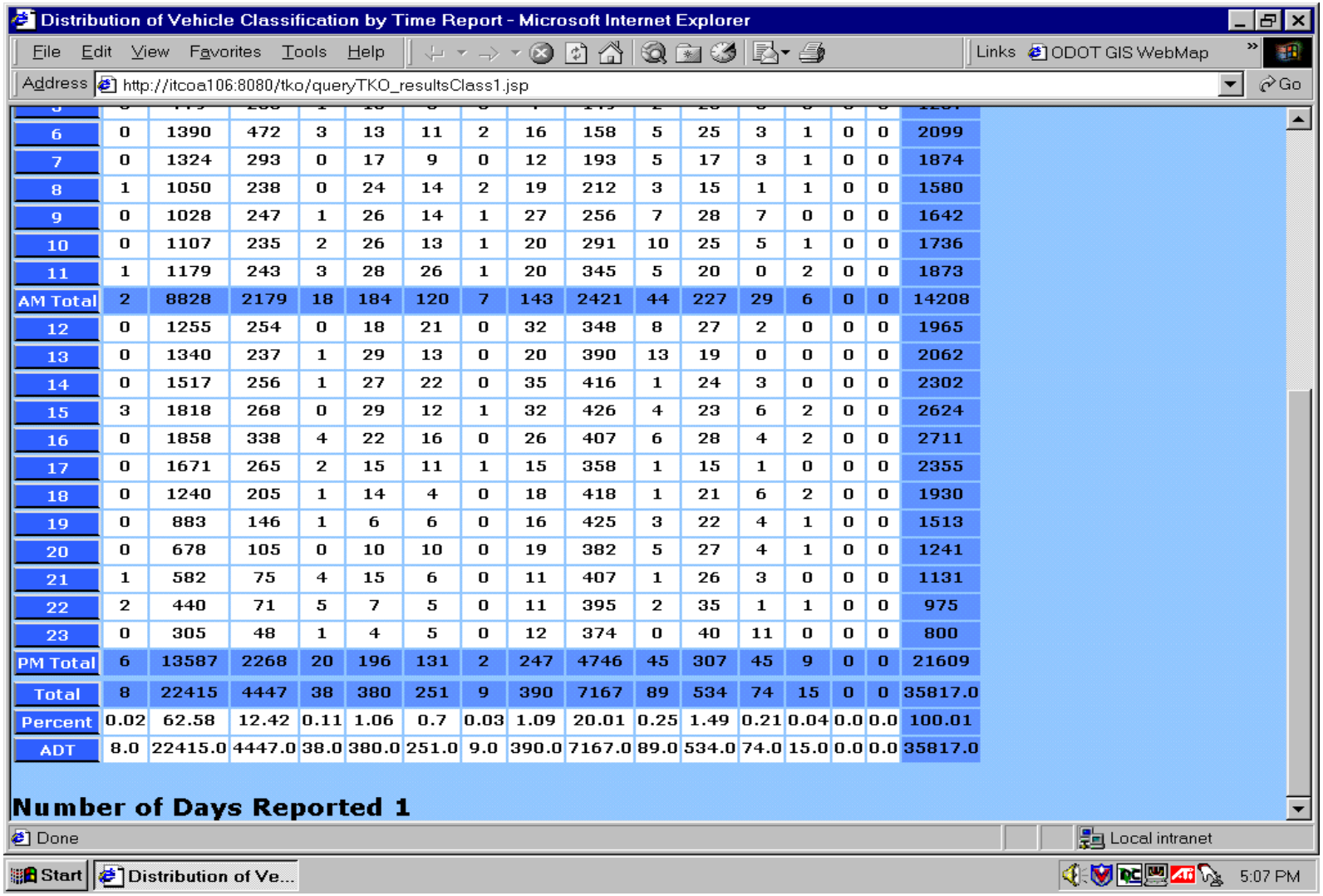
Ohio Department of Transportation
Office of Technical Services
Traffic Monitoring Section
Distribution of Vehicle Classification by Time Report

Station: 000531 County: LIC 00070-16.540 Location: 0.9 MI E OF SR79

Date: 03-Jan-2000 to 03-Jan-2000

Hour	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
0	0	241	35	1	2	1	0	5	171	0	15	2	0	0	0	473
1	0	179	32	3	7	4	0	6	147	0	17	4	0	0	0	399
2	0	141	22	1	8	4	0	4	157	1	15	1	0	0	0	354
3	0	155	38	2	6	7	0	3	165	2	14	1	0	0	0	393
4	0	255	69	1	12	11	0	4	177	4	13	2	0	0	0	548
5	0	779	255	1	15	6	0	7	149	2	23	0	0	0	0	1237
6	0	1390	472	3	13	11	2	16	158	5	25	3	1	0	0	2099
7	0	1324	293	0	17	9	0	12	193	5	17	3	1	0	0	1874
8	1	1050	238	0	24	14	2	19	212	3	15	1	1	0	0	1580
9	0	1028	247	1	26	14	1	27	256	7	28	7	0	0	0	1642
10	0	1107	235	2	26	13	1	20	291	10	25	5	1	0	0	1736
11	1	1179	243	3	28	26	1	20	345	5	20	0	2	0	0	1873
AM Total	2	8828	2179	18	184	120	7	143	2421	44	227	29	6	0	0	14208
12	0	1255	254	0	18	21	0	32	348	8	27	2	0	0	0	1965
13	0	1340	237	1	29	13	0	20	390	13	19	0	0	0	0	2062

ODOT Interfaces – Reports

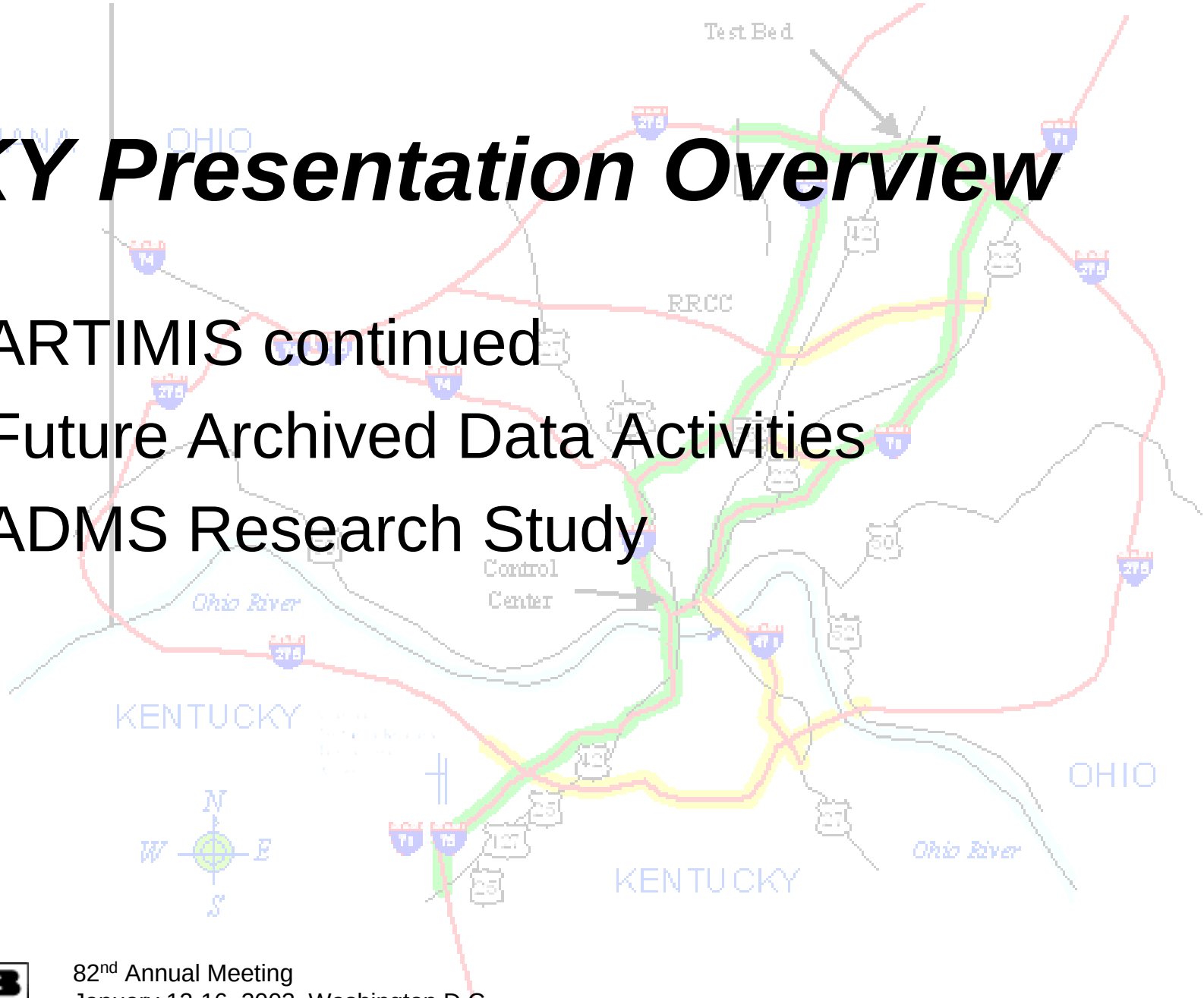


6	0	1390	472	3	13	11	2	16	158	5	25	3	1	0	0	2099
7	0	1324	293	0	17	9	0	12	193	5	17	3	1	0	0	1874
8	1	1050	238	0	24	14	2	19	212	3	15	1	1	0	0	1580
9	0	1028	247	1	26	14	1	27	256	7	28	7	0	0	0	1642
10	0	1107	235	2	26	13	1	20	291	10	25	5	1	0	0	1736
11	1	1179	243	3	28	26	1	20	345	5	20	0	2	0	0	1873
AM Total	2	8828	2179	18	184	120	7	143	2421	44	227	29	6	0	0	14208
12	0	1255	254	0	18	21	0	32	348	8	27	2	0	0	0	1965
13	0	1340	237	1	29	13	0	20	390	13	19	0	0	0	0	2062
14	0	1517	256	1	27	22	0	35	416	1	24	3	0	0	0	2302
15	3	1818	268	0	29	12	1	32	426	4	23	6	2	0	0	2624
16	0	1858	338	4	22	16	0	26	407	6	28	4	2	0	0	2711
17	0	1671	265	2	15	11	1	15	358	1	15	1	0	0	0	2355
18	0	1240	205	1	14	4	0	18	418	1	21	6	2	0	0	1930
19	0	883	146	1	6	6	0	16	425	3	22	4	1	0	0	1513
20	0	678	105	0	10	10	0	19	382	5	27	4	1	0	0	1241
21	1	582	75	4	15	6	0	11	407	1	26	3	0	0	0	1131
22	2	440	71	5	7	5	0	11	395	2	35	1	1	0	0	975
23	0	305	48	1	4	5	0	12	374	0	40	11	0	0	0	800
PM Total	6	13587	2268	20	196	131	2	247	4746	45	307	45	9	0	0	21609
Total	8	22415	4447	38	380	251	9	390	7167	89	534	74	15	0	0	35817.0
Percent	0.02	62.58	12.42	0.11	1.06	0.7	0.03	1.09	20.01	0.25	1.49	0.21	0.04	0.0	0.0	100.01
ADT	8.0	22415.0	4447.0	38.0	380.0	251.0	9.0	390.0	7167.0	89.0	534.0	74.0	15.0	0.0	0.0	35817.0

Number of Days Reported 1

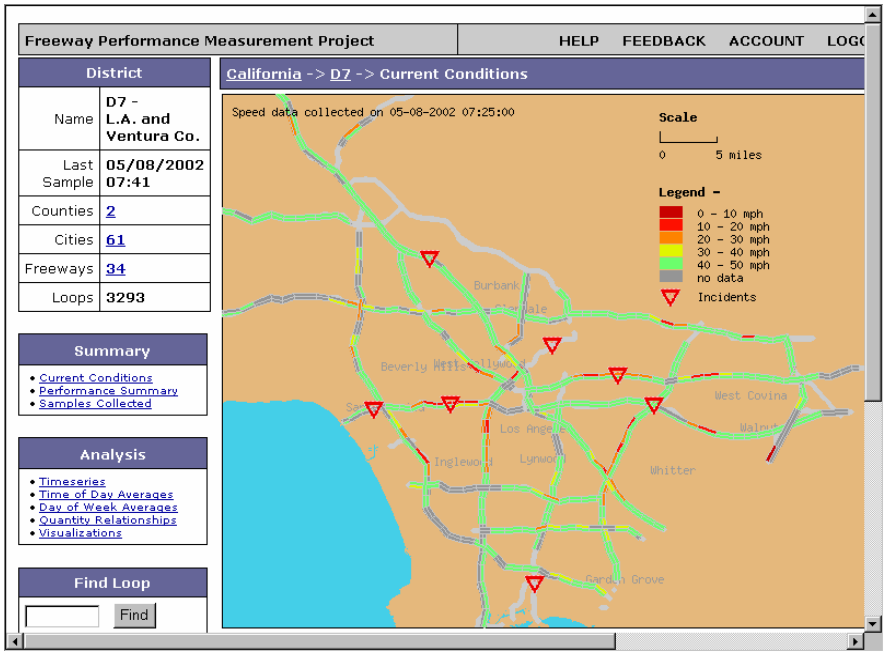
KY Presentation Overview

- ARTIMIS continued
- Future Archived Data Activities
- ADMS Research Study



ARTIMIS Archiving Plan

- Computer programming
  - Create new data formats
  - Create pre-designed queries/reports
- Data web page
  - Queries/reports for historical data
    - ADTs
    - Truck percentages
    - Speed summaries
    - Incident data
  - Downloads
  - Example: PeMS (CA)



ARTIMIS Archiving Plan

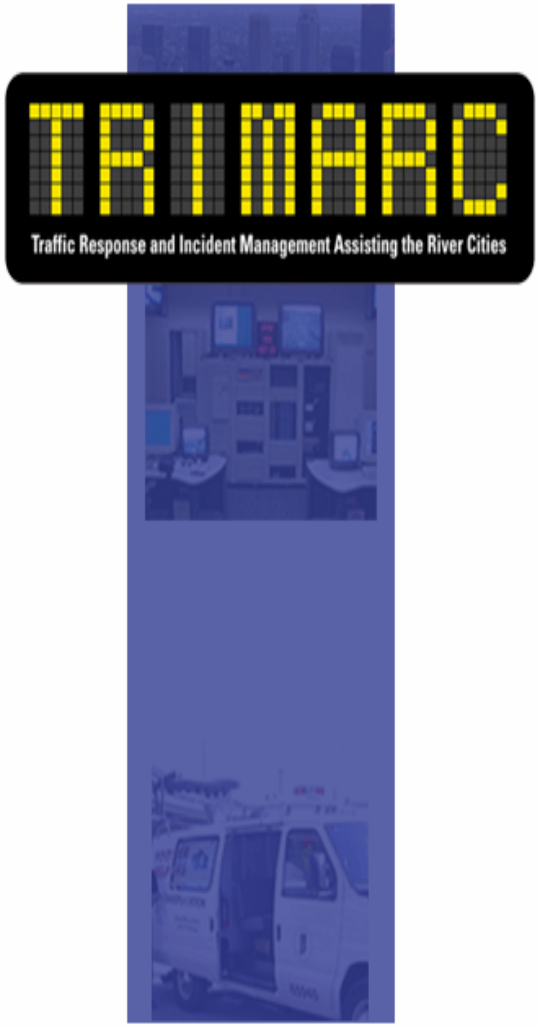
- Equipment Investigation
  - 170 controllers can't process classification data
  - Use off-the-shelf traffic counter
  - Need to collect occupancy data
  - Advantages: new technology, more memory, more capability

Future Archived Data Activities

- Implement New ARTIMIS Archived Data Plan: data formats, web page, GIS coverage, new equipment
- Use of Data for Mobility Performance Measures: Use actual data instead of estimated data for congestion management analysis, e.g. Travel Rate Index
- Expansion of ARTIMIS: more interstate coverage plus major arterials

Future Archived Data Activities

- Feedback to other Regional ITS systems
  - ARTIMIS archived data plan will be the blueprint for both Kentucky and Ohio ITS systems
- Other ITS systems "watching" ARTIMIS:
  - TRIMARC - Louisville Freeway Management System
  - Columbus Freeway Management System
  - Central Kentucky Congestion Management System



TRB

Archived Data Management System (ADMS) Research Study

- University of Kentucky Trans. Center
  - 2.5 year study
  - Create new entity for archiving data: ADMS
  - Approximate cost $190,000
- Other partners
  - 3 KYTC divisions
  - ODOT
  - 2 ITS systems
  - FHWA

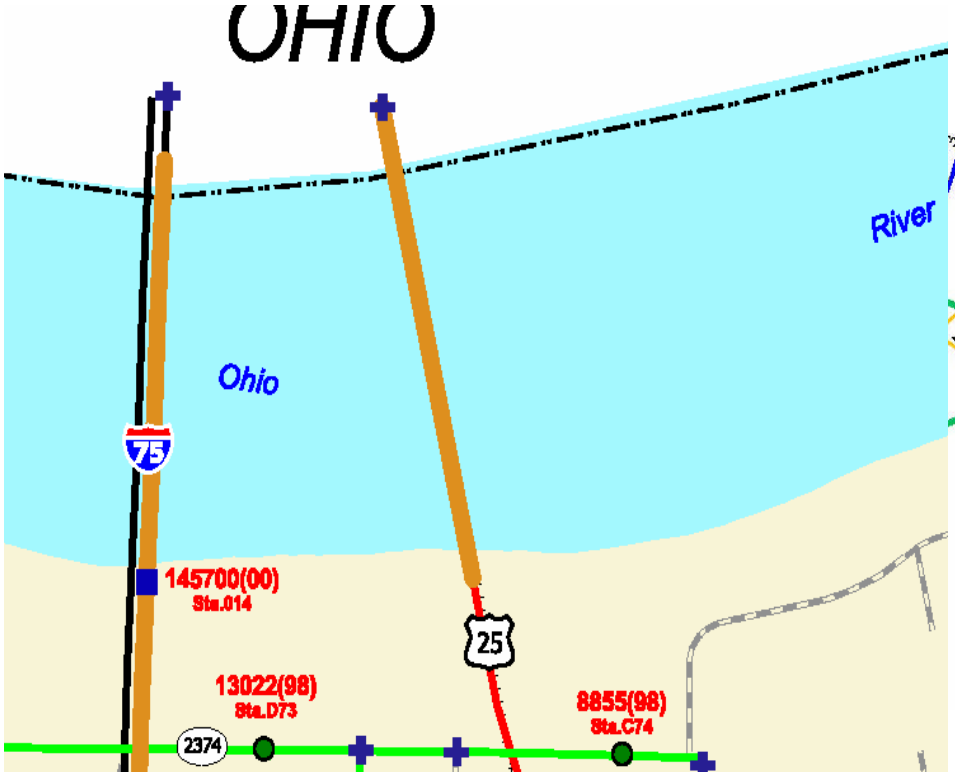
TRB

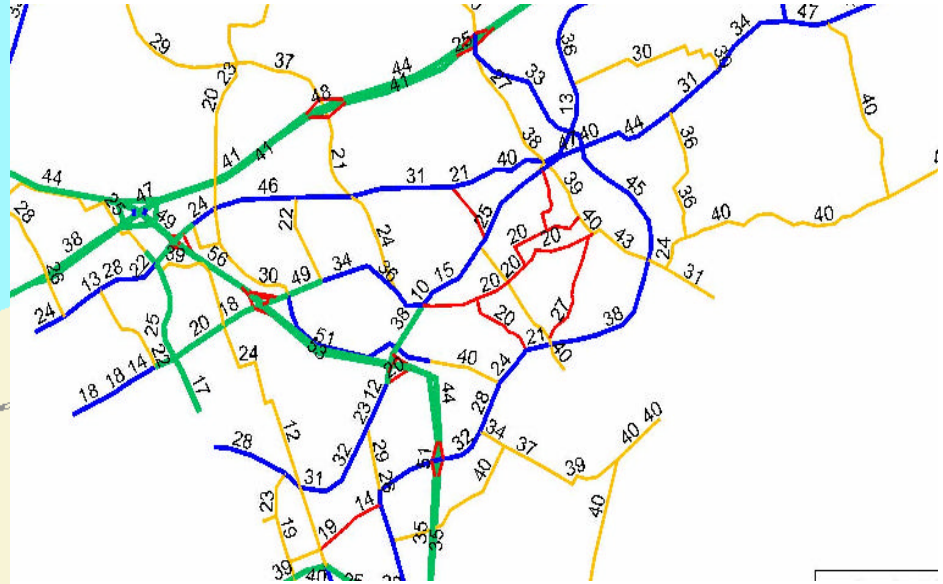
ADMS Research Study

- Features
  - Online Query Capability
    - Architecture
    - GIS interface
    - Software development
  - Data quality algorithms
    - Use of national subcontractor?
  - Short term: analysis of data for HPMS using off the shelf techniques

ADMS Research Study

- Implementation of GIS for each ITS system
  - Spatial analysis could maximize value of archived data
  - Obstacles: different software (3 different agencies), Operations typically doesn't use GIS
  - Examples of Traffic GIS: volume counts, model speeds





ADMS Research Study

- Data Quality
  - Usual checks: repeats, range checks, zero data, historical consistency
  - Shawn Turner flag example:

Descriptive name: DETECTOR_MissingVolumeRecord_code

Symbolic Name: VOLMS_CD

Definition: A code that describes the primary cause of a missing volume record.

Representation Layout: 99

Valid Value Rule: Valid Value List: 0=other, no additional information required; 1=other, additional information required; 2=original data; 3=data missing due to a malfunction (eg, hardware, software, equipment, etc); 4=data missing because no vehicles present (for speed only); 5=data missing because of quality control edit; 6=data missing because of previous controller/TMC QC edit; 7=data missing because of disabled or unavailable function.

ADMS Research Study

- Other Products
  - New uses of ITS data (e.g. security, evaluation of ITS system)
  - Blueprint for TMS data analysis?
- Issues
  - "Sell" data to users (e.g Planning, AQ)
  - Continuation of ADMS center (by UK?, how do new ITS systems fit in?)
  - Prototype for use by others? (Step up FHWA!!)

Conclusion

- **ARTIMIS is the launching pad for Ohio and Kentucky's archived data activities.**
- **Other archived data efforts include a research study in Kentucky that will establish an independent ADMS.**
- **Thank you for your attention!**
- **If you have questions or comments, please send email to:**
  - **dave.gardner@dot.state.oh.us**
  - **rob.bostrom@mail.state.ky.us**